DOCUMENT RESUME

ED 216 873 SE 037 438

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TITLE The Aviology Concept Program. Resource Monograph #21. Revised.
INSTITUTION Florida Univ., Gainesville. P. K. Yonge Lab. School.
PUB DATE 81
NOTE 42p.

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Aerospace Education; Aviation Technology; *Course Descriptions; Interdisciplinary Approach; Physical Sciences; *Program Descriptions; Science Activities; *Science Curriculum; Science Education; Science Instruction; *Science Programs; Secondary Education; *Secondary School Science; *Units of Study
IDENTIFIERS *Aviation Education

ABSTRACT

This program, consisting of 10 instructional modules (or units), evolved from "Aviology", a course created in 1971 in response to needs expressed by Florida students and teachers for a course that would present the important concepts of physics. Each of the 10 modules has three sections: (1) purpose; (2) instructional approach; and (3) summary of activities, an annotated, sequential list of all activities included in the module. Module titles include: (1) Man's Preoccupation with Flight; (2) Getting From One Place to Another; (3) Building A Plane; (4) The Science of Moving Purposefully Through the Air; (5) Anatomy of Weather; (6) Physical Effects of Flight on People; (7) Contemporary Aviation; (8) Effects of Aviation on Society; (9) Careers with Aviation; (10) Environmental Ramifications of Aviation. Although these modules, using an interdisciplinary approach, may be taught in sequence for a year-long aviation course, one or more may be selected and used as part of a general science, social science, or career guidance program. (JN)

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Educate Through the Aerospace Vehicle

Tell me, I'll forget
Show me, I may remember
But involve me and I'll understand.

– *Chinese Proverb*

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AVIOLOGY CONCEPT

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The Concept

An innovative, effective, and exciting program relating to the students' lives through activities and actual hands on experience.

The Reality

"You'll see kids do things this year that they have never done before. Kids who have sat doing nothing in years past start actually trying. That's the reality.

Aviology Concept Program

The Aviology Concept Program is a proven, effective teaching paradigm that can be used by both science and non-science teachers with and without aviation skills or background.

The task to produce a literate public has traditionally fallen on the schools. A survey of Florida public schools found most teachers not willing to take on a subject that was considered by most as "out of field." On the other hand, looking at the few teachers who were teaching "aviation education," ground school or other aviation science courses, it was found that they were certified across the board from elementary to vocational and at every grade level. Many teachers expressed an interest in aviation education at national and state meetings and workshops held at P.K. Yonge Laboratory School. They indicated they would be interested in teaching aviation education in their classes if they did not have to be experts on aviation and had activities and teacher guide materials that could be injected into their existing courses. A survey of aviation education programs nationwide found few programs to meet those criteria. Of the programs found, one had packaged materials that were available for classroom teachers. The need was evident.

Aviation and space experiences stimulate the intrinsic movitation to learn.

Out of this need, the **Aviology Concept Program** was developed at P.K. Yonge Laboratory School, University of Florida.

Aviology is a highly motivating approach to learning. We define aviology as the study of the science and art of flight and mankind's fascination with flying – its effects onour surroundings, on our society, and on us.

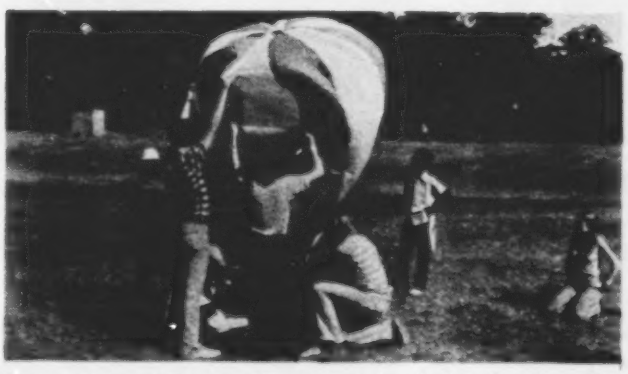
In its broadest sense Aviology includes the study of anything that flies, glides, or soars through the air – why it moves, how it moves, and the effects of its movement. Thus, the study of Aviology might consider airplanes, rockets, birds, insects, wind-born seeds, perhaps even marine organisms "flying through the oceans." No single discipline of study is sufficient to fully understand Aviology. Mathematics, literature, art, psychology, economics, history, physics, biology, geography, meterology, and many more must be a part of the study of Aviology. In its essence, then the **Aviology Concept Program** uses flight to excite and motivate students to learn in nearly any area desired.

Success is the best way to convince someone that they can succeed. So in the **Aviology Concept Program** we have attempted to design activities that with the teacher's help can be successfully completed by nearly every student. Our desire is that students learn to enjoy learning, not just that they become convinced that they don't know.

Aviation and space education can help open the formal classroom.

The problem posed by designing and flying paper airplanes, model rockets, or building a realisitc mobile of the solar system break both student and teacher of the time and subject restraints that have characterized contemporary education. Mathematics takes on meaning when calculating parachute areas, plotting a simple flight in an airplane or center of pressure for your own rocket. History, physics and other disciplines can be woven into the interests that arise from involvement in aviation and space activities.

Aviation and Space Education Integrates Learning in Meaningful Patterns



The Aviology Concept Program also helps develop the abilities to speak and write in a meaningful manner.

THE AVIOLOGY CONCEPT PROGRAM

by

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Revised Spring, 1981

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This public document was promulgated to disseminate information to public school personnel at an annual cost of $3255.00, or a per copy cost of $ .93.

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PREFACE

The physical sciences, so basic to most everything one does, are frequently rejected or overlooked by both students and teachers. Perhaps the reason for this rejection is largely a matter of communication--these sciences having become so abstract that, as presented in college, most prospective science teachers avoid them, and those who do study these sciences find themselves trying to teach them to their students without the activities that relate to their students' backgrounds. Frequently, the result is that students are turned off rather than turned on by the sciences as presented. They turn their attention to other areas and may go through life with a lack of understanding of the concepts of physical sciences so basic to whatever they may decide to do.

Furthermore, individual differences, especially in the capability to do analytical thinking, make it difficult to teach physical science as a classroom activity where all progress at the same rate. Students must have the satisfaction of achievement--understanding--to continue studying any subject in a meaningful way.

The Aviology Concept Program overcomes both of these difficulties. First, it provides a wealth of activities that eliminate the communication gap, and second, it is organized in modules that permit individualized instruction with selections of study activities appropriate for a wide variety of capabilities and interests.

What was originally planned as a year-long course, mainly in physics, has developed into a series of ten interdisciplinary modules. These may be taught as a year-long sequence or as selected modules; others may be selected as components of a general science, social science, or career guidance programs; parts of modules may be used in an interdisciplinary course. Where sufficient equipment and flight facilities are available, selected modules may be used as a pre-flight aviation course.

Following are illustrations of the many uses a teacher might make of the Aviology Concept Program:

1. A teacher of an inter-disciplinary course might select one or more of these modules:

   Man's Pre-occupation With Flight
   Getting From One Place To Another
   The Science Of Moving Purposefully Through The Air
   The Physical Effects Of Flight On People
   Effects Of Aviation On Society
   Careers With Aviation
   Environmental Ramifications Of Aviation

2. A teacher of a general science course might select from these:

   Building A Plane
   The Science Of Moving Purposefully Through The Air
   Anatomy Of Weather
   Contemporary Aviation

3. A teacher of a social science course might select from these:

   Man's Pre-occupation With Flight
   The Science Of Moving Purposefully Through The Air
   Effects Of Aviation On Society
   Careers With Aviation
   Environmental Ramifications Of Aviation

4. A teacher of a guidance course might select from these:

   Getting From One Place To Another
   The Science Of Moving Purposefully Through The Air
   Contemporary Aviation
   Effects Of Aviation On Society
   Careers With Aviation
   Environmental Ramifications Of Aviation

Many other possibilities come to mind, but these suggestions are sufficient to evidence clearly that the Aviology Concept Program offers an opportunity for teachers to provide satisfying experiences in the physical sciences in a wide variety of situations. Further, these experiences are such that their students should be able to use the basic concepts of science in their daily lives.

N. E. Bingham, Professor Emeritus
College of Education, University of Florida,
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Association for the Education of Teachers of
Science (AETS)

INTRODUCTION

A major part of the business of education involves motivating students to learn facts, skills, ideas, and attitudes that we, as teachers, have identified as vital or enriching to their lives. Thus, teachers continually are searching for effective ways to capture a student's imagination and interest, directing them toward important learnings. Sometimes we create memorable experiences for students in hopes that they will want to learn more about those experiences and about the related subjects we wish to teach them. Other times, we insist that students learn what we have to offer and use force to encourage them. Occasionally we are fortunate enough to find students coming into our classrooms with the desire to learn already a major force in their lives.

Whatever the source of motivation, each student must have a personal reason to learn in order for our efforts to have any lasting effects. Thus, the development of courses built around topics that tend to have an inherent, special interest for students seems to be a viable approach to motivation--so long as the central purpose of the course is to teach important content, attitudes, and skills.

Most people think of aviation education as a course to train people to fly. It can be this, but it can also be much more. A sizable portion of our nation's youth are intrigued, even enraptured, by the idea of flying, and they want to know more. Thus, aviation education provides a means for teaching much of importance--why and how things fly, how flying affects the human body, how aviation affects our society and our environment, how to understand the weather, and how principles of science apply to the construction of an aircraft.

Aviation education, in the true sense, is aimed not only at the would-be pilot but also at the non-pilot public--the 99% of the population that uses the commercial air carrier. When one considers that, during 1973, the nation's air carriers totaled over one hundred and ten billion passenger miles (over 2.4 times as many passenger miles as all the other commercial transportation modes put together), it becomes evident that some form of aviation education, at least in the general sense, is a must.

Aviation education encompasses far more than scientific and technical facts about flying: the psychological effects of that first trip on a commercial jet, the possible economic and environmental ramifications of a community airport, the scheduling of an airline trip, the possibility of an aviation-related career, and the factors of safety and time as these relate to choosing to fly in preference to driving. These understandings of aviation assure mobility to a nation of literate citizens.

The task of producing a literate public has traditionally fallen on our public elementary and secondary schools. Examination of the history of education shows that the basic skills of reading, writing, and math were the primary, and many times the only, subjects taught in our early schools, while the family or community artisans instructed in the vocational-technical matters.

Today, the mission of the public school has changed only to the extent of offering an option of vocational-technical training along with academics; however, the major responsibility continues to be that of producing a functionally literate public. In the United States that means acquiring wide diversity in both knowledge and experience; i.e., a general education. To provide such education requires one of three things--many teachers, each with expertise in separate disciplines; a few teachers with highly diverse competencies; or the type of teachers who make up the majority of active teachers in our modern American schools today, well-grounded in basic content of a discipline but flexible and open to advances in our technology. The latter stands challenging at the forefront of education, preparing our children and youth to become actively literate participants in governing and maintaining this nation.

In a survey of Florida public schools, the few teachers who were teaching "aviation education," ground school type or otherwise, held certificates in a variety of subject areas, including both academic and vocational at every grade level. In high schools, social studies, science, and vocational teachers were the ones most likely to teach an aviation course. Surprisingly, many of these teachers were not pilots. All, however, reported having experienced pleasure with aviation through international commercial flights, the military, an interest in model aircraft, or a pleasant trip in a small aircraft. The survey also indicated that, although many teachers felt that teaching an "aviation" course would be considered "out of field," the critical factor is a high interest and a basic background in aviation on the part of the teacher.

It is encouraging that many teachers are expressing interest at state and national professional meetings and at the workshops held at P. K. Yonge Laboratory School. Interest in including the study of aviation in their classes increases upon discovery that qualifying as an aviator is not necessary in order to inject aviation-related activities and experiences into existing courses. On the Florida survey, however, interested teachers did report a need for course materials and teacher's guides. A survey of aviation education programs nationwide found few programs which could provide materials. Of the programs found, only one had packaged materials that were available to help classroom teachers.

The need was evident. In response, the Aviology Concept Program was developed at P. K. Yonge Laboratory School, College of Education, University of Florida. A description of program development procedures follows.

THE AVIOLOGY CONCEPT PROGRAM

Background

The Aviology Concept Program evolved from Aviology, a course created in 1971 in response to needs expressed by Florida students and teachers for a course that would present the important concepts of physics in a practical manner. Aviation as a topic was selected because response to a survey sent to all Florida public and private high schools indicated that aviation was of interest to approximately 14,600 students. Specifically the survey revealed that:

. . . 48% of the students would like to take a course like Aviology.

. . . 51% have flown in a commercial aircraft; 31% in a private aircraft.

. . . 29% were interested in an aviation-related career.

. . . 16% of the 198 Florida High Schools polled had an aviation curriculum in their schools.

The potential for stimulating interest in physics through aviation was apparent; hence, support was sought for program development and evaluation. Support was found within the Florida Department of Transportation and the Federal Aviation Administration (FAA). Field evaluation, involving five Florida schools, was carried out during the 1972-73 school year. The program was successful not only relative to achievement in science but in attitudes toward the subject of science and school in general. A more detailed description of the program and results of the study may be found in the FAA publication Aviology, #GA-300-98.

Examination of the results of the "aviology program" led investigators to the conclusion that a comprehensive treatment of the topic would require that many educational disciplines be blended together under one unifying theme--aviation. Thus, the aviology program was subjected to an interdisciplinary modification, culminating in a program of ten modules encompassing concepts inherent in many fields of science, social science, the arts, basic skills, and careers. Designed to meet the needs of various levels of academic achievement among students in grades 10-12, the course was entitled the Aviology Concept Program to distinguish it from the Aviology Program completed earlier and cited above.

Definition

Aviology is defined as the study of the science and art of flight; mankind's fascination with flying; and its effects on our surroundings, on our society, and on us. In its broadest sense, aviology includes the study of anything that flies, glides, or soars through the air. Why does it move; how does it move; what are the effects of its movement. Thus, the study of aviology considers airplanes, rockets, birds, insects, wind-borne seeds, even marine organisms "flying" through the oceans. No single discipline of study is sufficient to understand aviology fully. Mathematics, literature, art, psychology, economics, history, physics, biology, geography, meteorology, and other areas of knowledge and thought are components of the study of aviology. In its essence, then, the Aviology Concept Program uses flight to excite students to learn in practically any area desired.

The modules compiled as the Aviology Concept Program were found to be highly motivating to students in eight Florida field test schools during the 1975-76 school year.

Nature of Instruction

Useful learning requires that the student be (1) able to learn, (2) willing to learn, and (3) apply learnings in ways that enhance the meaning and permanence of their learnings.

Each student is an individual; all students who are mentally equipped to learn are not necessarily open to assimilating all of the ideas and materials presented. Some students, for example, learn better through listening, some through reading, some through pictured displays. Some need concrete experiences, others are annoyed by having to do anything but use logical reasoning. Some students can learn well on their own, while others require close supervision and guidance.

Ideally, learning situations and instructional materials suited to the needs of each learner should be readily available. The Aviology Concept Program has only begun to move in the direction of individualizing for students. Tools such as Cognitive Style Mapping and Myers-Briggs Type Indicator are providing insights into the nature of individual students and suggesting ways in which learning materials and activities may be shaped to meet individual needs. Thus, the Aviology Concept Program materials have been designed to include a variety of instructional modes aimed toward the differing aptitudes of students found within a class. The importance of a student's attitude toward himself as a learner is also recognized.

Promoting a positive self-concept through insuring that students experience a lot of success is a major aim of the program.

Consequently the program is highly activity oriented, requiring students to move about, to communicate, to experiment, to create, and to act upon what they are learning.

Evaluation of the program found students at all grade levels to be enthusiastic about flight. Even those who have no desire to ride in an airplane seem excited about the ideas stimulated by the study of flight. At the high school level students become aware of hundreds of flight related careers that they never knew existed and, at times, find employment, both temporary and permanent, as a result.

Students who are both able and willing to learn are still faced with the problem of retaining what they have learned and using it in worthwhile ways. To assist retention a conceptual framework with which new ideas may be associated is provided in a unified, interdisciplinary content. This approach meshes together the various disciplines of science and applies the knowledge to examine problems and issues in our world. Thus, curricula are organized around various unifying themes, focusing on concepts that underlie all areas of science; processes that are used in the attainment of new knowledge, no matter what area of science; phenomena and persistent problems, whose understanding require the study of many areas of science, interrelated in both simple and complex ways. One component of the Program, for example, centers on the phenomenon of flight as a unifying concept for the disciplines of science as well as other disciplines--such as psychology, sociology, or history--embracing the same concept.

Activities featured tie student's learnings directly to their daily lives. Thus, in learning the use of aeronautical charts, for example, students also learn to read a road map. A compass is needed to navigate on the ground as well as in the air. In studying contemporary aviation, students learn to organize and operate an aviation related business or a club, using techniques they can apply to any business or club. When they tackle the problems of the effects of aviation on society, students study the effects of aviation near them on people they know. The approaches used may be applied to any other social concern.

When learnings are put to use right away and used often, they are more likely to last. When one learning is associated with another and then both are tied to a centralizing framework, the learnings are recalled within a framework and the pieces are attached to it. When the relationships between different areas of learning and different areas of life are seen, then the learnings take on additional, perhaps even deeper, meanings. The learner then begins to find new ways of associating and applying pieces of knowledge and understanding. New ideas and new solutions are the result. These, then, are the learnings that ultimately impact our world. As a consequence, the study of aviation is not only exciting and fun but meaningful to the student and important to the society as a whole.

Structure of the Program

The Aviology Concept Program consists of a series of ten instructional modules (or units). Each module is built around a single key aspect of flight and is composed of a substantial set of activities and readings engaging students in learning about the module topic. The modules are designed to be usable as separate units. Thus, for a year-long course the order in which they are taught is not critical. Several of the modules, though, may be more effective near the beginning of a course as basic subject matter; others are more effective near the end when students have accumulated sufficient background. Each module may also be taught separately as a mini-course or incorporated into an existing course to provide additional stimulation or a new perspective. The activities of the modules include readings, assignments, laboratory investigations, field experiences, individual and group projects, games, simulations, value sheets, and suggestions to the teacher for discussions, films, field trips, and speakers. In many modules, activities are grouped together into two or more segments of instruction. Thus, the teacher can easily skip portions of a module if desired or pull out smaller segments for use within the context of a different course. In addition, the approaches used in several units (especially the last four) are sufficiently novel that they may be used as models for designing activities for other classes.

Thus, development intended to produce a program which provides both structure and flexibility. Teachers will take the materials of the Aviology Concept Program and modify and rearrange them to suit the individual needs and opportunities unique to their students and educational settings. The fact that the program consists of enough instructional materials to last for 1½ to 2 years forces teachers to make some choices in their selection of materials to use in a one-year course. Ultimately, each teacher will create a program for the study of aviation education for his or her own instructional situation.

Overview

Each of the ten Aviology Concept Program modules has three sections: (1) Purpose, (2) Instructional Approach, and (3) Summary of Activities. The first two are described here in fairly general terms, since they are treated in detail in the instructional materials. The Summary of Activities is an annotated, sequential list of all activities included in the module.

THE AVIOLOGY CONCEPT PROGRAM LIST OF MODULES

1. Man's Preoccupation With Flight

2. Getting From One Place To Another

3. Building A Plane

4. The Science Of Moving Purposefully Through The Air

5. Anatomy Of Weather

6. The Physical Effects Of Flight On People

7. Contemporary Aviation

8. Effects Of Aviation On Society

9. Careers With Aviation

10. Environmental Ramifications Of Aviation

Module 1: Man's Preoccupation With Flight

Purpose

The primary purpose of this module is to convey and instill in students some of the excitement and wonder felt by all who fly or dream of flying.

Other Major Purposes are:

. . . to teach the history of aviation;

. . . to introduce current attempts to find new ways of flying (e.g., lifting bodies, sky diving, gyrocopters, pedal planes, hang gliders);

. . . to share some of the ways people express their excitement about aviation as a theme in music, art, and literature; and

. . . to demonstrate some of the difficulties involved in creating something that flies.

Instructional Approach

This module uses a mix and match approach with

. . . 2-3 weeks of sequenced material designed for the beginning of the course, plus

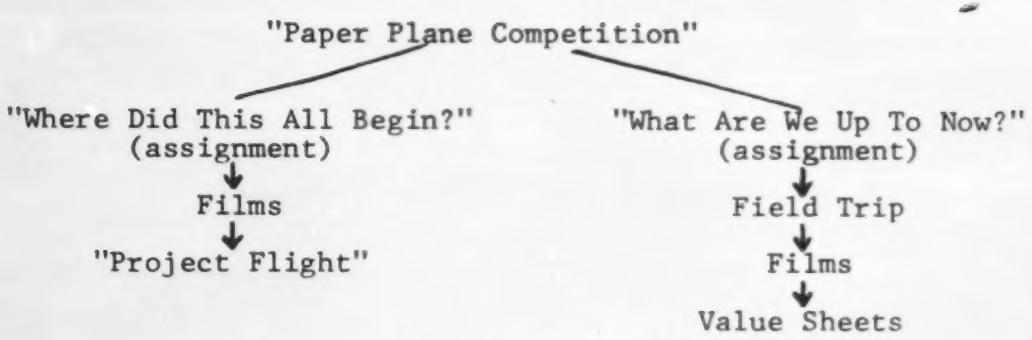
. . . an assortment of activity packets of a more opportunistic nature to take advantage of "teachable moments," to remotivate students, or to provide a break in routine throughout the year.

The module is project and activity centered, using both brief and major projects, as well as field trips, value sheets with literature and music, and films.

Summary of Activities

Basic sequence for beginning the year

Two tracks are offered. One is historical; the other current. Depending on time and interest, either one or some combination of both can be used.



"Paper Plane Competition"

This two-day introductory event is designed to stimulate interest, enthusiasm, and early involvement in creating things that fly. In addition, students are introduced to streamlining, lift, and control surfaces.

Day 1--On the first day, a competition is held without prior warning. Each student builds and flies three paper airplanes--one for a distance competition, one for duration of flight, and one for maneuverability.

Day 2--Each student, as a homework assignment, brings in one paper plane, designed to accomplish one of the three purposes, and enters the plane in one of the three competitions.

"Where Did This All Begin?"

People and events in aviation history are the subjects of this assignment.

Films

Free loan films are available to show early attempts to fly. Many are also available showing current attempts to fly.

"Project Fly Away"--Phase I

Students design and build a craft of some sort and attempt to fly it. Then they analyze their mistakes. They also research the history of this type of craft.

"What Are We Up To Now?"

This is an assignment to find out about current unique attempts to get into the air, from hang gliders to lifting bodies.

Field Trip

Select one exciting site and go visit it. We suggest taking the students soaring (pay their own way). It's fun to watch and do. However, there is apt to be a long ground wait so plan other activities at that site to maintain interest.

Value Sheets

Man's preoccupation with flight is evident in music, poetry, and literature. Value sheets based on items such as Superman Comics, the poem "High Flight", and the song "Up, Up and Away", cause students to become alert to relevant occurrences as activities direct them to examine the content of some inspiring or controversial item, determine how it relates to the idea being studied, and expressing their own feelings and values concerning the item.

Opportunities throughout the year

Activities throughout the year should be grouped so as to support one another and support the material currently being studied rather than as completely isolated pieces. For example a field trip, a project, and some related literature might go well together.

"Project Fly Away"--Phase II

Near the end of the year, students redo the projects from Phase I of "Project Fly Away" or make new projects and again fly them. This follow-up activity helps students realize how much progress they have made during the year.

Module 2: Getting From One Place To Another

Purpose

The primary purpose of this unit is to introduce students to the concepts and tools of navigation and help them build a basic level of proficiency in navigation.

To accomplish this, students study basic global geography, latitude and longitude, chart reading, topographic representations, the use of plotters, the use of computers, dead reckoning, relative motion and frames of reference, vectors, airspace agreements, radio navigation systems, and in-flight navigation.

Instructional Approach

This module is probably bast taught as a unit, building from one activity to the next. In most parts there is heavy emphasis on student activity and less emphasis on reading or listening. The module consists of five segments: (1) Around the Globe, (2) Reading and Using Navigation Charts, (3) VFR Navigation, (4) IFR Navigation, and (5) In-Flight Navigation. Selection of which segments to use should be based on student background and course depth.

Summary of Activities

1. Around the Globe

This section has two assignments designed to introduce students to basic geography, make them aware of latitude and longitude and the differences in time around the earth, and acquaint them with the differences between ruhm line navigation and great circle navigation.

The activities are self-directed but should be preceded by a discussion or film on time zones, GMT (Zulu Time), and the international date line. After the "Great Globe Race" is completed, discuss the advantages of great circle navigation.

--"Travel Time": an assignment on time (also used in Module 6 The Physical Effects of Flight on People")

--"The Great Globe Race": short competitive investigations involving using the globe and various charts to lay out best routes for travel and make schedules of dates and times

2. Reading and Using Navigation Charts

This section consists of five activities designed to make the student comfortable using maps and charts.

--"Grid Work": an activity to determine how various projections are made and actually do one for a fictional world

--"Hills and Valleys": an activity to determine how topographic maps are constructed and to actually make one

--"Look At All of Those Charts": a comparison of the various aeronautical charts

--"Chart Talk": an activity in understanding chart symbols

--Handouts and discussions summarizing and explaining the variety and use of charts and introducing the plotter

--"Plotting the Way": activities in using plotters to determine distance and heading

3. VFR Navigation

The section on VFR (Visual Flight Rules) Navigation introduces students to the ideas of motion, calculation of speed, the use of wind triangles, computer use, and course plotting.

--"Movin' On": a team experiment using cars or bikes in measuring distance, speed, and time (also found in the "Physical Effects of Flight on People", Module 6)

--Discussions and demonstrations: appropriate on computers, relative motion, frames of reference, vectors

--"Which One of Us Is Moving?": assignment on reading combination which introduces relative motion and progressively moves students to using wind triangles

--"Vectors": experiment in relative motion involving students swimming in moving water

--Discussion: dead reckoning, to pull together ideas already considered and introduce plotting

--"Plot-a-Course": activities in cross country course plotting. Teacher assigns route. Student does flight plan and answers questions.

--"Cross Country" game: very appropriate if weather module has been completed. (Commercially available as "Flight Simulator" by Aero Products Research, Inc.)

--"Airspace": a continuation of "Plot-a-Course," but students are given directions that lead them across international boundaries. Dilemmas develop.

4. IFR Navigation

This is an open ended section. Magazine articles, discussions and field trips are very useful here. Also, a table-top instrument simulator such as the ATC 510 or 610 would be of value in giving students a feel for how aircraft instruments really work.

The "Instrument Navigation Project" should be one of the final activities of the section.

--"Get Lost": an experience in running compass courses of varying complexities

--"Instrument Navigation Project": written report project

--Articles on VOR, ADF, ILS, MLS, R-Nav, Inertial Navigation Systems

--Films

--Field trip to the airport

--The ATC Flight Simulator would be of use here in understanding the workings of the Navigation systems. (Analog Training Computer, Inc.)

5. In-Flight Navigation

This culminating section is primarily film and field trip oriented.

--Films

--Field trip to regional control center, tower, approach and departure control

--Speaker: either an experienced pilot or ATC person

--"Talk Back": attempting to read back instructions or information taken from COMM. radio and possibly then follow the instructions to make needed corrections in flight path

Module 3: Building A Plane

Purpose

The primary purpose of this module is to familiarize the students with the design, materials, instrumentation, and safety features of aircraft.

Other Major Purposes are:

. . . to help students become competent in explaining the relationships between instrument readings, the movement of control surfaces, and the response of the aircraft;

. . . to introduce students to the two primary instrument systems-gyroscopic and pilot-static, and to accurate instrument reading; and

. . . to impress upon students the importance and meaning of the pre-flight check of the aircraft.

Instructional Approach

This module consists of four segments: (1) Design, (2) Materials, (3) Instruments, and (4) Safety. Each of these segments could be taught separately or combined as a total unit. The closure activity is designed to pull together ideas studied about aircraft in designing a special type of aircraft of his own--a bird.

Summary of Activities

1. Design

The design section consists entirely of a project that will acquaint students with different aircraft and their design.

--"Those Amazing Flying Machines": projects where each student chooses one kind of aircraft (Jane's Aircraft of the World is a good reference). For this type of aircraft each student does the following:

constructs a wood or plastic model of that type of aircraft, explains in a verbal presentation to the class or in a written report the aircraft's structure, control surfaces, power plant, and other important characteristics.

2. Materials

This section is designed to demonstrate the strengths and weaknesses of aircraft design and construction.

--"To Bend an Airplane": an experiment on tempering metals

--Discussion concerning the importance of properties of materials in aircraft construction and operation

--"Corrosion Proof": an experiment on corrosion and corrosion proofing

--Handouts

--"Crush Proof": an experiment on structural strength

--Field trip to aircraft construction plant or repair shop

3. Instruments

This section is devoted to the basic aircraft flight instruments and the science behind their operation. If desired, the study of aircraft engines and engine instruments could be appropriately included at this point. There are no activities, however, designed for that topic.

--"Straight and Level": if available, the ATC 510 simulator can be quite useful in learning the operation of instuments. If not, a static mock up or several visits to a real aircraft will help some.

--Films

--Examination of inner workings of discarded aircraft instruments

--"The Top of the World": a total body experiment on gyroscopes

--"Magnetic": an activity designed to study the operation and proper use of a magnetic compass

--"Working Under Pressure": an experiment on pressure using a vacuum chamber and an aneroid barometer

--"Whistling in the Wind": activities using a pitot-static system (Dwyer wind gauge--Dwyer Instruments, Inc., Michigan City, Ind.)

--Discussion on gyro and pitot-static systems

--"Control" games that teach the relationship between what the instruments show, what the control surfaces are doing, and how the aircraft responds

4. Safety

The safety section is important for pulling together concepts already discussed in previous sections. It deals with the safety of the aircraft only, not with regulations, personal safety, etc.

--Field trip to see cabin design and see a preflight check performed

--Discussion on aircraft safety features

5. Closure Activity

--"Build a Bird": the student demonstrates his understanding of aircraft by designing a bird. This involves a written report based on reading about and watching birds in flight, or one of several other alternative activities.

Module 4: The Science Of Moving Purposefully Through The Air

Purpose

The primary purpose of this module is to give students a solid foundation in the physical principles involved in flying, to help them relate these principles to concrete situations, and to help them gain an appreciation for these invisible forces of flight.

Other Major Purposes are:

. . . to develop competence in applying Newton's Laws in a basic level in explaining flight;

. . . to acquaint students with the controversy concerning lift;

. . . to introduce students to the principles involved in the control of aircraft flight;

. . . to develop competence in understanding and applying weight and balance principles and other rotational problems involved in flying;

. . . to help students identify and understand factors that decrease lift; and

. . . to acquaint student with types of airfoils and their uses.

Instructional Approach

Ideas considered in this module build on one another to reach a full understanding of the science of flight. Consequently, this module is probably best taught as a separate unit. The ideas lend themselves well to extensive student involvement and concrete experiences. There are three sections: (1) Forces That Make Planes Fly, (2) How to Get a Lift, and (3) Forces That Hinder Flight.

Summary of Activities

1. Forces That Make Planes Fly

a. Four Flying Forces

--Handouts: "Don't Move", "Issac Newton and the Foundations of Flight"

--"Movin' On - Part II": a total class experiment using cars or bicycles to study acceleration

--"Shootin' Newton": and experiment in examining the flight of a water rocket and the forces involved

--"To Drag or Not to Drag": an investigation of the factors involved in drag

--"Laws of Motion": an assignment helping students pull together the ideas of force and resulting motion

--Demonstrations: whole body activities in which students feel the effects of forces

--Films

b. The Great Controversy (Bernoulli or Newton)

--Handout "Bernoulli"

--"The Uplifting Debate"

--Films

2. How to Get a Lift (Types and uses of airfoils)

a. Flight Surface

--Handouts: introducing types of airfoils and how they are used

--Films

--"Bernoulli's Tube": experiment, a small wind tunnel is constructed and student-made balsa wood airfoils are tested for lift

--Discussion of how the student airfoils work

--"Flight Test": student-made balsa wood airfoils are attached to aircraft, flown, and compared as to flight characteristics, use, wing design, how well they glide, speed, maneuverability

--Field Trip: to see the real things

b. Control

--Handouts: "3 Axes", "Control Surfaces"

--Film: "How do Controls Control?" More work with the wind tunnel this time to see how a change in the control surface effects the behavior of the airfoil

--Discussion: to bring in the theoretical explanations for how control surfaces work

--"Flight Control": simulator game

3. Factors That Hinder Flight

a. Troublesome Torques

--Demonstrations: center of gravity, effects of rotation

--"Wait Your Turn": a series of quick experiments on rotational equilibrium

--"Pack Your Bags": Students are asked to pack for a trip within certain weight restrictions

--Discussions: of weight and balance

--Reading: "Propeller and Engine Torque"

--Balance Sheets: assignment on weight and balance

--"Gyrotation": torques and angular momentum using a bicycle wheel gyroscope

b. A Flow of Air (drag, stall, ice, dents)

--Discussions: safety

--Films (shell films good here)

--Handouts

--"The Will-O-The-Wind": a wind tunnel experiment concerning effects of drag, angle of attack, ice, dents, etc., on lift

--"Supersonic": activity on shock waves

c. Density Altitude

--Film

--"Pressure, Pressure, and Less Pressure": an assignment

Module 5: Anatomy of Weather

Purpose

The primary purpose of this module is to acquaint students with meteorological phenomena, weather reporting, and how these affect flight plans.

Other Major Purposes are:

. . . to help students develop initial competence in prognosticating the weather;

. . . to introduce students to electrical phenomena associated with violent weather;

. . . to give students a feel for and appreciation for the weather man; and

. . . to help students gain competence in reading weather reports and making decisions based on them.

Instructional Approach

Since this module includes a lot of subject matter and material that must build in some sequence in order to reach a full understanding, it is probably best taught as a unit. The approach is fairly conventional, building around activities, experiments, discussion, readings, and so on. The organization of material focuses on the study of a thunderstorm. Timing of the unit should correspond to the stormiest season in your area to provide plenty of real life experiences. In Florida we teach the unit to coincide with hurricane season.

Summary of Activities

Thunderstorm

See what you can do about arranging to have a thunderstorm for the first day of this unit. Look at thunderstorms, handout on thunderstorms, and films on thunderstorms.

Cloud

a. How are clouds formed and what are they?

--"Make a Cloud": experiment in which students actually make clouds in a bottle

--Handouts

--Discussion

b. How do clouds form in our atmosphere?

--"How Do You Dew?": an experiment assignment on dew point

--Discussion of adiabatic cooling, normal lapse rate, condensation

Electrical Phenomena

--"Van de Graaff": experiment using a Van de Graaff generator to study how electricity builds up in clouds

--"Sparky": experiments with static electricity

--"Lightning Safety": Reading

--Discussions of static electricity, lightning, and thunder

Winds and Air Circulation

a. Stability and air movement

--"Atmospheric Merry-Go-Round": an experiment on convection

--"Updraft": an experiment using a paraballoon to study updrafts and down drafts

--"Coriolis": a short experiment to show how the Coriolis effect works to make moving air spiral

--Discussion on air movement and local winds

--"Gaspard G. Coriolis and his Effect": reading

Air Masses and Movement

a. What is an air mass?

--Discussions of fronts, air masses, other storms, jet stream

--Handouts

b. What makes the mass move?

--Discussions of driving energy

--"Thermal Energy": an investigation of how heat works to produce air movement

--"Weather Project": a study of frontal movements as seen in newspaper weather reports

Charts and Forecasts

--Handout on types of reports

--Discussion on reading reports

--"Operation Weatherman": Students are given a week's worth of weather charts and data from the Flight Service Station and asked to analyze them.

--"Reading the Clouds": Students study clouds and weather for the next day.

--Speaker

--Field trip to Flight Service Station or weather bureau

To Fly or Not to Fly

a. The view from the pilot's seat

--Speaker: very experienced pilot to spin tales about weather he's seen

--Handouts

b. Comparison of planes and the weather they can fly in

--"Super Plane" assignment

--Handouts

c. Avoiding weather you can't fly in

--Discussion

--Speaker

d. FAR's re: weather

--"FAR's" assignment

Culmination

"What Do I Do Now?"

--Students are given bad weather situations and must decide what to do.

--(See Safety Corner in AOPA Pilot for ideas.)

Module 6: The Physical Effects Of Flight On People

Purpose

The primary purposes of this module are to convince students of the vital importance of caution, mental alertness, practice, and abstinence from drugs and alcohol for safe flying, and to demonstrate to them the enjoyable effects of safe flying.

This is accomplished by acquainting students with the physiological reactions, both positive and negative, that can be experienced in flying, and with the related FAR's. Included are vertigo, night vertigo, hypoxia, pressure effects, cockpit pressure, reaction time, three-dimensional operation, and euphoria.

Instructional Approach

This module consists of four segments: (1) The Eye and the Ear, (2) Time to React, (3) Chemistry in Flight, and (4) The Mental Picture. The module could be taught using all four of these or it could be pulled apart and each segment taught separately through the year.

Summary of Activites

1. The Eye and the Ear

When they don't agree--Problems!!

--"Vertigo": experiment in distance, speed, and time (also found in module 2)

--"Starts and Streetlights" and "Adaption Contraption": readings

--Films ("Eagle Eye Pilot" is especially good)

--Discussion: demonstration "The Workings of the Inner Ear"

--"Night Vertigo": experiment in a totally dark room

--Discussion: demonstration "The Workings of the Eye"

--"Vertigo and Vision": assignment

2. Time to React

--"Movin' On": experiment in distance, speed, and time (also found in module 2)

--Handouts: motion and reaction time

--"React": experiments in reaction time

--"Think Fast": role playing emergency decision making.

3. Chemistry in Flight

--Handouts on hypoxia, FAR's, drugs, drinking

--Films ("Charlie" is especially good)

--"React Again": an assignment of chemical reactions, flying, and safety

--"Ears-a-Popping": experiments in low pressures

--"Take a Breather": experiments in hypoxia

4. The Mental Picture

a. Time Zones

--"Travel Time": an assignment on time and time zones (also in Module 2)

--"Jet Lag": an assignment on the physiological effects of rapid travel through time zones

--Discussion

b. The 3-D World

--Discussion: the differences between operating in a 2-dimensional and 3-dimensional world

--"Up-Down-And-All-Around": an experience in three dimensions.

c. Cockpit Confusion

--"Chatter Box": practice in listening

--"Overload-Tilt": simulation of an overload of directions and information and observation of results

--Discussion

d. Enjoyment

--Flight experience

Module 7: Contemporary Aviation

Purpose

The primary purpose of this module is to familiarize students with the current state of aviation and with possibilities for the future of aviation.

To accomplish this, students study the roles of four categories of aviation--general, commercial, military, and space; the aircraft involved in each of these; the people and jobs involved; and the projected future of aviation in each category.

Instructional Approach

The study of contemporary aviation covers a very broad field. We see it including virtually everything that is happening right now in general, commercial, military, and space aviation. In each of these areas one could study what roles these types of avaition fill, the ways they operate, the types of craft involved both now and in the future, the people who are a part of each type of aviation and what is required of them, the rules governing their operation, and so on. This is all important but far too much to try to cover in a brief module. Consequently, to give students this broad picture without discouraging them, we recommend a game-centered approach. In teams students select and research one specific area of contemporary aviation. Then they compete in teams, role playing a group of people involved in that form of aviation, a company, a club, a military base, NASA, and so on.

Summary of Activities

Basic Overview (This should last about one week.)

To give students a rough idea of the total picture of contemporary aviation there needs to be an overview including:

--Field Trip to Experimental Aircraft Association activity, an air show, a modern airport, Cape Kennedy, an aircraft factory working on advanced planes, an appropriate museum (e.g., SST in Kissimmee), etc.

--Films with discussion

--Handouts on definitions, FAR's modern navigational aids

Teams

The class is divided into teams, each team taking one aspect of contemporary aviation--general, commercial, military, space. They should receive their team rules for the roles they will play in the game.

Preparation

--Team members divide up to research fully the role the team has chosen. They might use library research, telephone or letter inquiries and requests, interviews to obtain information.

--The team prepares a small written report on their aspect of aviation.

--The team makes a brief (approximately 10 minutes) panel presentation to the class. Another 5 minutes or so should be allowed for questions.

--Photos, charts, plastic models, etc., might be used with the presentation.

Game

In teams students select a role in contemporary aviation. They might play the game as an airline company, an agricultural spray business, a flying club, an FBO, a business relying heavily on the use of several planes, a military base, or NASA. The object of the game is to operate successfully for one year. At the beginning of the year, goals are determined by people and cargo to be moved, fuel to be used, money to be spent, and hours to be flown. Throughout the year each team must make expenditures for fuel, operations, maintenance, and purchases in attempting to reach their goals. Of course, during the year, chance and numerous dilemmas affect the progress toward the goals. The game is played as a total class.

Module 8: Effects of Aviation on Society

Purpose

The primary purpose of this module is to introduce students to the impact that aviation is having on our world--at the local level, national level, and world-wide level.

Other Major Purposes are:

. . . to help students gain an in-depth understanding of at least one way in which aviation affects us;

. . . to help students reason through the values and feelings concerning that issue or situation;

. . . to introduce students to the people involved in making decisions about the issue or situation; and

. . . to teach students how to gain information useful in resolving the issue or situation.

Instructional Approach

This module is probably best taught as a unit. Rather than attempt to cover all facets of the effects of aviation on society, we suggest an in-depth study of one or only a few. The focus of the module is a "Meet the Press" involving community leaders discussing a topic of local interest. Class activities consist of preparing for, carrying out, and analyzing the results of this panel interview. The module could be repeated with a new topic if there is time and interest. As an alternative, students could deal with topics of a more global nature either instead of or in addition to the "Meet the Press." Suggestions for this alternative are given in part B.

Summary of Activities

1. "Issues and Aviation"

--Overview: The class lists effects of aviation on society and related issues and briefly discusses them.

--Topic selection: This selection may be done either by students, or the teacher, or both. It could take place either ahead of time or only after considering many alternative possibilities.

--Value Sheets: May be included to give students a more personal feel for the topic that is chosen. Preferably teacher developed.

--Update: Students carefully search for recent articles specific to the area of study. They may also wish to use books, legal cases, television programs, etc., so that they will be as up to date on the topic as possible. The result of this activity should be an organized set of notes.

2. "Meet the Class"

This approach is especially appropriate for dealing with topics such as the ones listed below. Potential panelists are listed with each topic.

--airport (location, business, modification)
Airport Manager/Politician/Regional Planner/Citizen

--mass transit
Politician/Airport Manager/Airplane Manufacturer/Regional Planner

--invasion of privacy by plane (police copters, Spy in the Sky)
Police/ Politician/Security Guard/Citizen

--local uses of aviation (shark patrol, agriculture)
FBO/Airport Manager/User Airplane Owner

--military base benefit vs. danger and noise
Commander or Associate/Local Politician/Private Citizen living near base

--legal cases involving aviation related situations (aircraft impoundment)
Aviation Lawyers/Aviation Insurance men/FAA/Border Patrol

--security - skyjacking
Security man/FAA/Airline Persons/Citizen with strong feelings

--Questions: Students write questions to be submitted to the Meet-the-Class panel.

--Answers: A panel of community leaders meets with students in a "Meet-the-Press" format to address the issue and answer the students' presubmitted questions.

--Conclusions: After tabulation of the results of the panel, the class reaches conclusions about the directions for the future in the particular area studied.

3. "Probe"

In dealing with more global topics such as the ones listed below, the panel approach may not be appropriate. However, these topics should not be eliminated from consideration. Students may simply have to rely more on literature, letters, and telephone interviews. Some of these topics include:

--increased accessibility to services and to remote areas

--warfare and aviation

--supersonic transport (SST)

--uses of space

--mixing of cultures due to rapid transportation

--mass accidents

--international business and aviation

--aviation and national and international economics

This investigation leads to a class-written report and a fair-type display of posters, demonstrations, verbal explanations, models, etc., that could be presented to parents and to other classes in the school.

Module 9: Careers With Aviation

Purpose

The primary purposes of the module are to acquaint students with the wide variety of careers related to aviation and to provide an opportunity for them to investigate, in depth, the career of their choice.

Other Major Purposes are:

. . . to acquaint students with the requirements for entry in various careers and with the types of employers involved; and

. . . to help students determine how various careers related to one another in the support of aviation activities.

Instructional Approach

The activities of this module should not be taught as a separate unit. Instead they should be interspersed and meshed throughout the entire program (of whatever length). To study careers in the isolation of a single unit could become confusing and boring.

Using the activities as a part of the total approach, teachers can:

--capitalize on student selection of topics to be studied,

--capitalize on the momentary interest of the class as well as the long-term interests of the individual, and

--capitalize on current events involving aviation-related careers.

Summary of Activities

1. "Career Kickoff"

To introduce students to the great diversity of aviation-related careers, the teacher will need to spend a couple of class periods discussing, showing films and film strips, and providing readings that give an overview of aviation-related careers. This should be kept fairly brief.

--"I'm Leaving on a Jet Plane": Value Sheet on Careers

Each student (or team) at the beginning of the year will identify the aviation-related career that is the most interesting to him or her. Preferably careers should not be duplicated. Then, throughout the year, the student is:

--responsible for investigating the career through reading, interviewing, etc., for bringing his career into class discussion whenever applicable, and for staying current and keeping the class current on people and recent developments involved in that career.

--responsible for a major instructional public relations session of his or her career. This could involve a field trip, speakers, posters, class discussion, role play, debate, or other approaches. (Note: One field trip could cover three or four occupations. The students, of course, should make all the arrangements for the trip.)

--responsible for keeping brief notes on the other careers discussed.

--invited to develop an optional activity related to the career (e.g., a game, role play). A sample activity could be led by the teacher at some appropriate time during the year.

2. "A One-Way Ticket To Timbuktu" (a sample career activity)

This activity is designed to familiarize students with the complex process of airline ticketing and the function of a travel agency. Teams of two students actually write their own tickets. A good follow-up would be to invite a representative of a travel agency to talk to the class or even host a field trip to the agency offices.

3. "Career Convention"

Near the end of the year, a total class activity is needed to pull together and make use of all of the learning that has occurred during the year about aviation-related careers.

Exhibits

Students could set up displays and exhibits much like those that would be seen in the commercial exhibits section of actual professional conventions. Student evaluation of the exhibits along with teacher evaluation is very effective.

Workshops

"Matrix"

--The class is divided into teams (at least three) and each team develops its own (Sanderson-type) list and matrix of careers. In-class comparison of the lists and matrices results in an improved overall list and rewards the outstanding team.

"Job Web"

--In teams, students develop a web showing the relationships of various jobs to one another in aviation, similar to a food-web in ecology.

"Check Point"

--Each team or individual writes a series of questions concerning careers. The questions can be then used as a test or given by one team to another, with a third team judging the number of points to be awarded to each team on the basis of the quality of the questions and answers.

General Session

"Career Panel"

--A general panel discussion of all careers studied considering the relative merits, futures, and importance of the careers. The panel could be composed of students or of community resource people.

Module 10: Environmental Ramifications Of Aviation

Purpose

The primary purposes of this module are to involve students in building an awareness and investigating the positive and negative effects of aviation on our environment.

Other Major Purposes are:

. . . to help students reason through the values and feelings involved in these issues and situations;

. . . to help students improve their ability to investigate controversial questions using library research, interview, and field techniques;

. . . to demonstrate to students a decision-making process involved in reaching accord on a plan for action;

. . . to help students view aviation's relationship with the environment from an objective and realistic point of view.

Instructional Approach

This module is probably best handled toward the end of the course after students have built sufficient understanding and background knowledge to raise significant questions and to make intelligent decisions concerning the environmental ramifications of aviation. The module uses a task force to involve students in investigating real environmental issues and attempting to find reasonable solutions. Involvement, such as this, is far more effective than reading, lecture, or discussion in studying environmental topics.

Summary of Activities

1. "The Fix We're In"

a. Environmental Situations Lists

To build an awareness and feeling for the environmental effects of aviation, both positive and negative, students are asked to make an extensive list of environmental situations in which aviation plays a major role either as a part of the problem or as a part of the solution. Also, the teacher should on several occasions, where appropriate, use value sheets to give more depth of feeling for the problems and alternatives involved. This use of value sheets will also help students become aware of additional situations and of other points of view.

b. Selection

From the list, the students now select those situations that are particularly applicable to their local area.

2. "Task Force"

Divide into task force teams (about 6 per task force) with each team taking one situation to investigate.

a. Investigation

Each task force consists of 3 teams of 2 people:

Team A--library research to determine how the situation problem has been handled elsewhere and how extensive the problem is.

Team B--interview appropriate people in community to get their perceptions of the situation, plans, and solutions.

Team C--field work collecting scientific data about the situation in the local community (e.g., decibel/meter/land survey/ atmospheric conditions).

b. Consensus

Must be reached by each task force on the nature of the situation and most appropriate solution. A report is written and presented to the class.

c. Action Debate

The class will determine which, if any, of the situation-solutions should be carried through with community action and how it should be done.

d. Decision

An in-class discussion as a wrap-up on the question "Is aviation beneficial or detrimental to the environment?"

e. Action

If deemed appropriate by the class, would give students an opportunity to really attempt to effect change in their community. The learning can be tremendous if there is sufficient time to carry through.

The Aviology Concept Program provides the teacher and student with a wealth of activities as ten interdisciplinary modules. The modules can be taught as a sequence, making Aviology a year-long course, or they can be selected and used as parts of a general science, social science, or career guidance program.

10 Interdisciplinary Modules

- ***Man's Preoccupation with Flight*** – to instill the excitement and wonder felt by all who fly . . . or dream of flying.
- ***Getting From One Place to Another*** – introduces basics of navigation and builds a proficiency in same.
- ***Building A Plane*** – familiarize students with design, materials, and safety features of aircraft.
- ***The Science of Moving Purposefully Through The Air*** – solid formulation of the physical principles and to relate these principles to actual situations.
- ***Anatomy of Weather*** – meteorlogical phenomena, weather reporting, and how these affect flight.
- ***The Physical Effects of Flight on People*** – physiology of flight and safety (no drugs; reaction times, etc.)
- ***Comtemporary Aviation*** – current state of aviation and future anticipated growth of aviation.
- ***Effects of Aviation on Society*** – impact on society at local, national, and worldwide level.
- ***Careers with Aviation*** – wide variety of careers related to aviation.
- ***Environmental Ramifications of Aviation*** – investigating the positive and negative effects of aviation on the environment.